the promotion of the interests of science, and for the educational benefits that have been conferred through their agency on all branches of the American community. Learning some time since from a notice in NATURE that Mr. Saville-Kent was about to resign his late curatorship of the Brighton Aquarium, Messrs. Appleton at once placed themselves in communication with that gentleman with the view of securing his aid in their scheme. As a site, New York offers remarkable inducements for the establishment of a marine and fresh-water aquarium on the magnificent proportions intended, the sea and the Croton river being equally available for the supply of the two descriptions of water required, while as a position for the acquisition of specimens to stock its tanks its advantages cannot be over-estimated. The art of transporting fish from one distant locality to another has been already practised under the auspices of the "American Fisheries Commission," on a larger scale and with more momentous results than have been obtained on this side of the Atlantic, through means of special cars fitted up with tanks. These last appliances will prove of eminent service and importance for the ordinary transfer of aquarium specimens, while a slight modification of the same might be adapted for accommodation on ship-board, and for the conveyance of fish from distant seas. In fact, starting with this proposed aquarium in the Central Park, the future aim of high-class aquaria should and will doubtless be, to as perfectly represent in its tanks the marine fauna of every quarter of the globe as Menageries and Zoological Gardens do at present the terrestrial inhabitants. The most solid and important advantages, however, likely to arise from an institution founded on the basis of the New York scheme, are associated with the pre-endowed system on which it is to be established; this of itself constitutes a guarantee for the attention to, and accomplishment of, scientific results unattainable in connection with any similar undertaking set up as a mere commercial speculation, and necessarily weighted with the many antagonistic interests upon which its financial profits are dependent. The time again could not be more ripe than the present for projecting the proposed scheme, a sufficient number of aquaria having been established in this country and on the Continent to illustrate the advantages or defects attendant upon the several principles of construction which have been hitherto attempted, as also to indicate the special modifications yet required to make them thoroughly efficient for biological research.

It is to be hoped that the meritorious example set by America will not be lost on this country. England, with her great resources, richly indented coast-line, and innumerable populous centres scattered along the latter, offers remarkable facilities for the establishment of a large zoological station and aquarium, and which, conducted under the auspices of a body of scientific men, with a trained naturalist to superintend it, could not fail to yield the most valuable results. In the absence of sufficient funds forthcoming from private sources for free endowment, the self-supporting system initiated by Dr. Anton Dohrn at Naples offers singular advantages. His scheme of letting out laboratory tables to various universities, governments, and scientific bodies is particularly worthy of notice. The fact that Cambridge has consented to take a share in one of these tables, while testifying to the praiseworthy spirit of that University, carries with it at the same time a severe censure upon the insufficiency of the means provided for scientific investigation nearer home. A well-appointed marine aquarium with suitable laboratories established at Torquay, Plymouth, or such other desirable locality, could not fail to command the support of our leading English universities, and it might be anticipated that also of many others in France, Belgium, Denmark, and other countries of Northern Europe, too far removed to profit fully by the advantages of the Naples station. Through the supply of specimens for class demonstration, such an institution might also derive a considerable income. One of the great disadvantages under which science courses are at present conducted throughout this country arises from the difficulty of obtaining for dissection typical examples of the commonest representatives of our marine fauna and flora, all of which might be furnished regularly and at a low rate through the medium of a large seaside aquarium, towards which is constantly flowing from every side an amount and variety of material more than sufficient for its own requirements.

TUBES FOR SILENT ELECTRICAL DISCHARGES*

RUHMKORFF'S induction coil is now a classical instrument found in every laboratory. It is constantly employed to obtain the sparks intended to combine gases in eudiometric analyses, but its use is not limited merely to effecting combinations, it effects also decompositions, another property utilised in chemistry, particularly to show that at the moment of its decomposition into nitrogen and hydrogen, ammonia gas doubles its original volume. We never obtain, however, in this experiment, a perfectly accurate result, for the induction spark which separates the ammonia gas into its elements is also capable of determining anew their combination to reform the original gas. It exercises thus two actions of a perfectly opposite kind, one of which seems due to true electric action, and the other to the heat which accompanies the passage of the spark.

It would certainly be advantageous to separate these two actions, since they are capable of acting in opposite directions, and it is especially in the preparation of ozone that this separation would be valuable, since ozone, which is easily formed under the influence of the spark, is destroyed by the action of heat. For the purpose of more easily obtaining ozone M. Houzeau has recently constructed an apparatus worked by a Ruhmkorff coil, in which there are no longer sparks, but only dark discharges—*effluvia*—far more efficacious in the production of modified oxygen.

It is known that at the end of last century, Van Marum noticed a peculiar odour in the vicinity of an electric machine giving large sparks, and that he attributed this odour to electricity. In 1840 Schœnbein showed that oxygen disengaged by electrolysis from water has this same odour, and preserves it after being kept in well-stoppered phials; he gave to the substance characterised by this odour the name of ozone.

There remained, however, some doubts as to the real nature of this substance, until the investigations of M. Marignac and of De la Rive in Switzerland, and MM. Fremy and E. Becquerel in France. They succeeded in demonstrating with precision that it was merely pure oxygen which assumed, under the electric influence, a new form. Researches on this modified oxygen soon accumulated, and chemists investigated it with the greater ardour, thinking that in studying this particular form of oxygen, they were touching that important question of simple bodies which at present remains the "great unknown" of chemistry.

So far as research has gone, ozone appears to be a strongly oxidising gaseous body, of one and a half times the density of oxygen, and possessing affinities infinitely more energetic than the latter. Thus it can oxidise cold silver, which so strongly resists the action of ordinary oxygen, it can inflame pure phosphuretted hydrogen, can burn ammonia, transforming it into nitric acid, and can displace the iodine of iodide of potassium. All these properties have been observed in the traces of ozone contained in oxygen submitted to suitable treatment, and the difficulty of obtaining appreciable quantities of ozone was not one of the least obstacles which stood in the way of continuous researches. Thus chemists and physicists have eagerly sought to discover a regular process of preparation, or at least a method of obtaining appreciable quantities of ozone. M. Houzeau, who has devoted much of his time and talents to the study of ozone, has recently devised an apparatus which is spreading rapidly among the laboratories, and which has already yielded very remarkable results, of which the following is a brief *résumé*.

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* Translated from an article in *La Nature*, No. 29.

The apparatus of M. Houzeau consists of two concentric tubes, the middle one enclosing a metallic wire, fixed to one extremity of a Ruhmkorff coil; the other wire, attached to the second pole of the coil, is rolled spirally round the exterior tube; finally, the gas circulates in the annular space comprised between the interior and exterior tubes, and, consequently, is not directly in contact with either of the two wires. The two metallic wires, along which the electricity flows, play the part of a Leyden jar, and the gas which circulates in the space traversed by the dark effluvia, by means of which the two different electricities shot along the wires are re-united, is essentially modified. If it be oxygen, it is charged with a notable quantity of ozone, whose odour rapidly spreads around the apparatus.

M. Houzeau's method produces oxygen much more charged with ozone than any other process; thus it has enabled some new properties of the gas to be discovered. Let the gas issuing from the effluvia-tubes come into contact with olefiant gas and the latter will be immediately set on fire with a loud explosion. M. Houzeau has devised a beautiful experiment, by introducing gradually into a somewhat large tube, a current of bicarburetted hydrogen, obtained by the reaction of sulphuric acid on alcohol; then by means of another narrower tube, penetrating about a centimetre into the tube filled with ethylene, he directs very gently a current of ozone, condensed as much as possible; the ozone which is introduced causes detonation.

When ozone is made to act on benzine a product is obtained, which, according to M. Houzeau, is essentially detonating; this ozo-benzine under concussion or pressure disengages suddenly a considerable quantity of gas, as do nitro-glycerine or the picrates, whose fulminating properties are well known. A few decigrammes of ozobenzine produce a detonation so violent that the windows of the laboratory are invariably broken, and thus only the very smallest quantities should be used in experiments; 3 to 5 milligrammes suffice to establish the eminently explosive properties of this dangerous substance.

M. Houzeau has also been able to show by means of his apparatus, the remarkable decolourising properties of ozone. If a solution of indigo is thrown into a bottle containing oxygen mixed with ozone, it is as easily deprived of its colour as if it were in contact with chlorine. It is known, moreover, that dyed stuffs are bleached by being simply exposed to the air, and as it is now proved that our atmosphere contains ozone, it appears very probable that it is this gas which is the active agent in the old process of bleaching on the grass.

Such are the new properties which M. Houzeau has been able to establish by employing ozone in a state of condensation infinitely greater than that which is presented when it was prepared by the old methods; and these results are certainly not the only ones which may be looked for.

M. Houzeau is not the only one who has made use of the tubes whose structure he has made known, and soon we may expect to see them modified so as to make them much more durable. M. Boillot, a writer well known to the readers of the *Moniteur*, proposes to substitute for the wire of M. Houzeau's tube, whalebone charcoal contained in the interior tube and in the space comprised between the gas-holding tube and a thin tube concentric with the first two; and M. A. Thénard has brought to bear on the construction of the tubes a further modification which makes them still more efficacious.

As is shown in Fig. 1. M. A. Thénard's apparatus is composed of three tubes of unequal length, welded together. The central tube *aa'* is filled with chloride of antimony in solution with hydrochloric acid; the negative pole B of the coil dips in the liquid which descends to the bottom of the tube at *a'*; the same solution of chloride of antimony is placed in the exterior tube E; it receives the positive wire of the coil at A. The liquid E E is then positively electrified, the liquid *aa'* negatively, and the gas which enters at C and issues at D, after having passed across the annular space between the two tubes, is submitted to the electric effluvia determined by the two opposite electricities of the two liquids.

Into the tubes thus arranged M. A. Thénard directs the gases on which he wishes the electric effluvia to act. One of those which he first submitted to this treatment was carbonic acid, which is decomposed in oxygen and carbonic oxide, with increase of volume. The experiment is perfectly clear, and such as to show the complete difference between the action of the effluvia and that of the spark. While carbonic acid submitted to the decomposing power of dark discharges contains about one-fourth of its volume of the mixture of oxygen and oxide of carbon, which proceeds from its decomposition, carbonic acid decomposed by the luminous sparks of a coil never yields more than 7·5 per cent.; for the latter act not only by their decomposing power, but also by their heat, which determines the combination of the gases as first separated, up to the moment when carbonic acid, oxygen, and carbonic oxide, are formed in such a state of equilibrium, the spark produces no further effect, the decomposition being equal to the combination. This equilibrium is reached when the mixture contains precisely 7·5 per cent. of carbonic oxide.

This experiment is not, however, the most curious of those which have been published during the course of last year by MM. Paul and A. Thénard working together in that laboratory in the place Saint-Sulpice, which is so liberally opened to all who wish to study.

M. Paul Thénard has noticed that marsh-gas sometimes contains equal volumes of carbonic acid and protocarburetted hydrogen, *i.e.*, it constitutes a mixture in which the carbon, the hydrogen, and the oxygen are found in equal quantities, as when they are combined in a very largely diffused organic matter—glucose. Has the effluvium the power of determining the union of these different elements, so as to reconstitute an organic substance? Such was the idea which MM. P. and A. Thénard wished to verify by making a mixture in equal quantities of formic acid and carbonic acid in one of their effluvia tubes, so arranged that the changes of volume which the gases may undergo are easily determined.

After ten minutes, the condensation of the gases was already sensible; it increased in time, and soon there was seen to appear upon the sides of the tubes a liquid possessing a strong refracting power, viscous, yellowish, which was found to be an organic substance of a somewhat high order, burning readily. Its nature has not been determined, but it is sufficient to prove the importance of MM. Thénard's experiment, that its formation has been established.

The synthesis of organic matters from the elements has always been one of the problems which profitably engage the attention of chemists; and vegetation, indeed, enables us to witness their formation by a series of reactions which we cannot reproduce in the laboratory. Is it not surprising, for example, that under the influence of light a leaf can decompose carbonic acid and water, both extremely stable substances, and which we can only reduce to their elements by means of the most elevated temperatures which we can produce? But this work which is accomplished in the leaf of a plant, the effluvium performs equally well; it decomposes water into oxygen and hydrogen. It can reduce carbonic acid to oxygen and oxide of carbon, just as happens in the green parts of plants under the rays of the sun.

As we learn by experiment that for one volume of carbonic acid decomposed by the green parts of plants, one volume of oxygen is given off, *i.e.* one volume of oxygen exactly equal to that of the carbonic acid, the decomposition of the latter being only partial, it is necessary that the water be forcibly decomposed in the same time as the carbonic acid, and that it yield us the half volume of oxygen necessary to complete that which appears at the moment of insulation, so that the decomposition is represented as follows :—

1 vol. carbonic acid = 1 vol. carbonic oxide + $\frac{1}{2}$ vol. oxygen.
1 vol. vapour of water = 1 vol. hydrogen + $\frac{1}{2}$ vol. oxygen.

The disengaged oxygen presents then a volume equal to that of the decomposed carbonic acid, and leaves instead carbonic oxide and hydrogen in equal volumes, which, on uniting, furnish in vegetables one of the products that are met with in young plants, glucose, which exactly represent the carbonic oxide and hydrogen, or, again, the carbon and the water. But this product has never been directly prepared ; it has been impossible, so far, to obtain it by synthesis, and all the attempts to unite the carbonic oxide to the hydrogen have been futile. There is, however, a problem of the same order which has been solved by MM. Thénard, and, in our opinion, is one of the most important points of their recent labours. They have not obtained, it is true, the organic matter, yet without a name, which was condensed upon their tube by directly combining hydrogen and the carbonic oxide, but by employing carbonic acid and formic acid, in which the elements are met with in the same proportions, in fact, instead of having

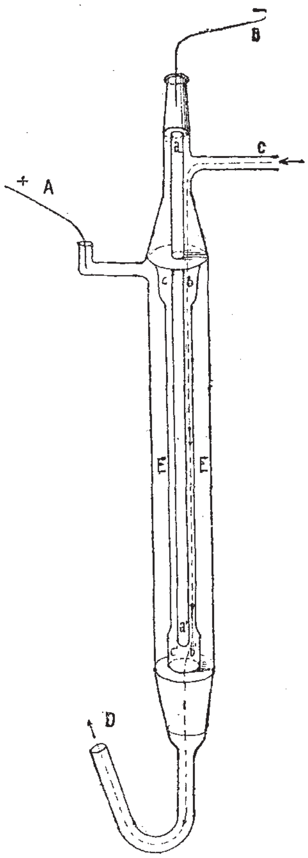

Fig. 1.—M. A. Thénard's Effluvia Tubes.

2 vols. carbonic oxide containing	1 vol. oxygen, 1 vol. carbon vapour.
2 vols. hydrogen.	

they have employed

4 vol. carbonic acid, containing	4 vols. oxygen, 2 vols. carbon vapour.
4 vol. carburetted hydrogen containing	2 vols. carbon vapour, 8 vols. hydrogen.

in which the oxygen and carbon, as in the first case, are in equal volumes, and the hydrogen in double volume. We may then regard the experiment of M. Thénard as opening a new way to the synthesis of organic substances, already so brilliantly studied by M. Berthelot.

The first apparatus employed by MM. Thénard presented a drawback ; the gases circulated with considerable difficulty, and their union was not so complete as could be desired ; they could not easily be renewed. MM. Thénard have got rid of this difficulty by means of the apparatus represented in Fig. 2. It will be seen that the electricity from the coil is distributed in the two tubes by cups filled with chloride of antimony, one forming the external tube, the other the interior, between which circulate the gases. These are kept in continuous motion by means of a very ingenious employment of mercury. By examining the figure it will be seen that the mercury placed in the large vessel, firmly fixed above the apparatus, can be let out drop by drop into the vertical tube on the right and carry along a certain quantity of gas imprisoned between two consecutive drops. The excess of mercury falls back into the vat into which the horizontal tube goes, while the moving gas received into a funnel which dips into the mercury, is brought into the annular space where it is subjected to the effluvia.

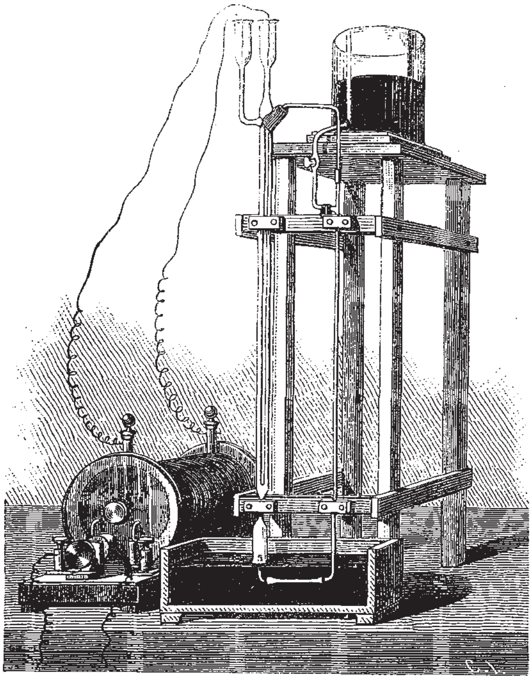

Fig. 2.—Apparatus employed by MM. Thénard to make gases circulate in effluvia tubes.

It is thought that if the gases in coalescing yield a liquid or solid substance, which can only happen by a great diminution of volume, it may be possible to introduce through the funnel placed under the mercury, a new proportion of the gases which, under the influence of the effluvium, will react upon each other.